

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Luc WOLFF et al.

Examiner: Prem C. Singh

Serial No.: 10/666,523

Group Art Unit: 1764

Filed: September 22, 2003

Confirmation No.: 5857

Title: PROCESS FOR COPRODUCTION OF PARAXYLENE AND STYRENE

BRIEF ON APPEAL

Mail Stop -Appeal Brief Patents

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

Further to the Notice of Appeal filed on October 28, 2008, please consider the following.

I. REAL PARTY IN INTEREST

The real party in interest is: Institut Francais Du Petrole.

An assignment of the application is recorded on reel 015881/frames 0223-0224.

II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to appellant or appellant's legal representative which will directly affect or be directly affected by or have any bearing on the Board's decision in the pending appeal.

III. STATUS OF THE CLAIMS

Claims 21-47 are pending in the present application.

Claims 1-20 are cancelled.

No claims have been withdrawn.

Claim 38 has been objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claim.

Claims 21-37 and 39-47 have been finally rejected.

No claims have been allowed.

Claims 21-37 and 39-47 are the subject of this appeal and appear in the attached Appendix.

IV. STATUS OF AMENDMENTS

An amendment after final was proposed in the response filed on August 28, 2008. According to the Advisory Action mailed on September 15, 2008, the amendments were not entered and will not be entered for the purposes of this appeal.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The invention claimed in claims 21-47 relates to processes for coproduction of paraxylene and styrene at a high level of purity starting from a stream containing xylenes, ethylbenzene and C₉-C₁₀ hydrocarbons (see page 2 lines 1-3, and page 6, lines 13-15). Substantially pure paraxylene is obtained and styrene at a purity of at least 99.8% by weight is obtained (see page 6, lines 16-17) from the processes claimed. By integrating the production of styrene into a paraxylene production loop, the fabrication of styrene does not require the alkylation of benzene (see page 6, line 8). In addition, by forming styrene, the amount of ethylbenzene that enters the paraxylene separation unit is reduced (see page 6, lines 10-11).

The process of this invention comprises the succession of steps recited in claim 21 and on page 9, line 8, through page 12, line 7, and illustrated in Figure 1, which comprise:

- a feedstock distillation step that separates xylenes,
- an adsorption step for the head stream of the distillation step that provides an extract (7a) and a refined product (7b),
- a distillation step for extract (7a), from which substantially pure paraxylene is obtained,
- a distillation step for refined product (7b) from which a distilled refined product (9b) (metaxylene, orthoxylene, and ethylbenzene) is obtained which contains a minor amount of ethylbenzene compared to the xylenes,
- a dehydrogenation step of the distilled refined product (9b) where at least 50% by weight of the ethylbenzene introduced is converted into styrene,
- a distillation step for the dehydrogenated product to produce a mixture (18),
- a step of separating mixture (18) into a stream (23a) containing 99.8% styrene and a second stream (23b) containing metaxylene and orthoxylene, and
- a step of isomerizing second stream (23b) to stream (25) containing paraxylene, orthoxylene, and metaxylene, which are recovered and are recycled upstream.

A more details regarding the steps performed in the process of this invention described on page 9, line 8, through page 12, line 7, are as follows:

The feedstock distillation to separate xylenes is performed in a distillation column (2). An overhead stream (3) comprising most of the metaxylene, paraxylene, ethylbenzene and at least part of the orthoxylene is withdrawn at the head. A stream (4) containing C₉-C₁₀ hydrocarbons and the remainder of the orthoxylene is withdrawn at the bottom.

The adsorption of overhead stream (3) is performed in an adsorption column (6) operating as a simulated moving bed and containing numerous adsorbent beds. The adsorption column comprises at least four operating zones:

a zone 1 for desorption of paraxylene, located between the injection of a desorbent (5) and the removal of an extract (7a),

a zone 2 for desorption of ethylbenzene, orthoxylene and metaxylene, located between the removal of extract (7a) and the injection of adsorption feedstock (3),

a zone 3 for adsorption of paraxylene, located between the injection of feedstock (3) and withdrawal of a refined product (7b) and

a zone 4, located between the withdrawal of refined product (7b) and the injection of desorbent (5).

The distillation of extract (7a) is performed in at least one distillation column (8a), from which substantially pure paraxylene (9a) is withdrawn and desorbent is withdrawn. The desorbent is recycled, at least in part, in the first adsorption column.

The distillation of refined product (7b) is performed in at least one distillation column (8b), from which is withdrawn desorbent (that is recycled at least in part in the first adsorption column) and a distilled refined product (9b) containing metaxylene, orthoxylene, and ethylbenzene, where ethylbenzene is present in a minor amount compared to the xylenes.

The dehydrogenation of the distilled refined product (9b) (consisting of ethylbenzene in an effluent containing styrene, metaxylene, orthoxylene, unconverted ethylbenzene and by-products) is performed in a dehydrogenation zone (10), during which at least 50% by weight of the ethylbenzene introduced is converted into styrene.

The elimination of the by-products of the dehydrogenation step is performed in a distillation column, to produce a mixture (18) containing mostly styrene, ethylbenzene, metaxylene, and orthoxylene.

The separation of mixture (18) is performed to produce a first stream (23a) containing styrene with a purity of at least 99.8% by weight is produced and a second stream (23b) containing mostly metaxylene and orthoxylene.

The isomerization of Second stream (23b) is performed in at least one isomerization zone, at the end of which stream (25) containing paraxylene, orthoxylene, and metaxylene are recovered and are recycled upstream from feedstock distillation column (2).

A subclass of the methods of this invention include those where the separation of the mixture (mixture 18) containing mostly styrene, ethylbenzene, metaxylene and orthoxylene is performed in a second absorption column operating as a simulated moving bed, (see page 6, line24-page 7, line 1). These methods are claimed in independent claim 43 and the claims which depend thereon (claims 44-47) and also dependent claim 22 and the claims which depend thereon (claim 27, 29, 30, 32 and 34).

An additional subclass of the methods of this invention specify conditions for the dehydrogenation of the distilled refined product (9b). These conditions do not require steam (defined in claim 44), do not require catalysts that contain iron oxide (claim 45) or chlorine (claim 46) but can employ catalysts that comprise tin and chromium (claim 47). The

disclosure on page 15, lines 6-17, describes the dehydrogenation conditions for such methods.

Particular embodiments of the methods of this invention define the minor amount of ethylbenzene within the distilled raffinate product that is dehydrogenated as 7% by weight. (page 19, line 16). These embodiments are claimed in dependent claim 42.

VI. GROUNDS OF REJECTION AND OBJECTION TO BE REVIEWED ON APPEAL

The grounds for the rejections are:

(1) Under 35 USC §103(a) as to whether claims 21-37 and 39-47 are obvious over Magne-Dirsch et al (US Patent 6,369,287) in view of Lee (US Patent 3,306,942).

(2) Under the doctrine Non-Statutory Obviousness-type Double Patenting as to whether claims 21-37 and 39-47 herein and claims 1-20 of US patent No. 6,841,714 are patentably distinct.

The ground for the objection is:

(3) Under 35 USC §132(a) as to whether the amendment filed on March 25, 2008 introduces new matter into the disclosure by the addition of new claim 44.

VII. ARGUMENTS

(1) Whether claims 21-37 and 39-47 are obvious over Magne-Dirsch et al (US Patent 6,369,287) in view of Lee (US Patent 3,306,942).

Magne-Dirsch et al (US Patent 6,269,287) is directed to a process for the co-production and separation of ethylbenzene and paraxylene. Magne-Dirsch et al. do mention that ethylbenzene production lines are generally integrated into a plant for producing styrene but they provide no guidance with regard to:

(1) where and how the process disclosed could be integrated into a plant for producing styrene, or

(2) the composition of a suitable feed from an ethylbenzene production line to produce styrene; or

(3) the conditions for dehydrogenating ethylbenzene to produce styrene.

The absence of a dehydration step for ethylbenzene within the disclosure of Magne-Dirsch et al. is acknowledged on page 5, lines 12-14 of the final office action. Therefore, the

primary reference is clearly deficient in meeting all the required elements of the methods claimed. Lee '942 does not make up for this deficiency such that the combined teachings of the Magne-Dirsch et al. and Lee '942 do not support a finding of prima-facie obviousness for any of the processes claimed.

One element that is missing from the combined teachings of the cited references is the step of dehydrogenating a mixture of ethylbenzene and xylenes (metaxylene and orthoxylene) to obtain styrene wherein the ethylbenzene is present in a “minor” amount. There is not even a hint or suggestion within the cited references “a distilled raffinate product containing metaxylene, orthoxylene and a minor amount of ethylbenzene compared to the xylenes” is suitable for any industrial process, including the preparation of styrene, without further purification.

At col. 2, line 62 through col. 3 line 20, Magne-Dirsch et al. disclose that a hydrocarbon feedstock brought into contact with a zeolitic adsorbent will provide:

a paraxylene rich fraction (recovered via line 4), and

a second fraction (recovered via line 3) that is low in paraxylene and high in ethylbenzene, and where an optional additional chromatographic zone is used,

a third fraction (recovered via line 3a) low in paraxylene, high in orthoxylene and metaxylene with essentially no ethylbenzene.

Magne-Dirsch et al. do not teach or suggest that any of these fractions is suitable for use in any industrial process, including the preparation of styrene by the dehydrogenation of ethylbenzene. There is no hint or suggestion the second fraction (recovered via line 3) which is highest in ethylbenzene content would be suitable for the synthesis of styrene with the paraxylene present. The disclosure by Magne-Dirsch et al. instead teaches that this fraction be brought into contact with a second adsorbent to provide a fraction of essentially pure ethylbenzene (col. 3 line 2). At column 8, lines 16-27 of Magne-Dirsch et al. the second adsorbent is said to recover ethylbenzene at 99% purity. Preparing styrene from such a fraction is not equivalent to dehydrogenating a mixture with a “minor” amount of ethylbenzene.

Lee '942 seeks catalysts with high selectivity to form styrene over toluene. The performance of a catalyst formulation containing an alkali promoter and a minor amount of combined chlorine is compared to a conventional dehydrogenation catalyst using ethylbenzene as a feed at purity levels ranging from 99.5 and 99.7%. There is no evidence

that Lee '942 teaches dehydrogenating a mixture with a "minor" amount of ethylbenzene or with xylenes present. Mixtures with ethylbenzene at 99.5-99.7% purity are significantly distinct from mixtures that comprise ethylbenzene in a "minor" amount compared to xylenes. Therefore, the dehydrogenation performed in the methods of the claimed invention is very different from the dehydrogenation methods disclosed by Lee '942 and no evidence has been presented that one skilled in the art would be motivated to reduce the purity levels of the ethylbenzene mixtures taught by Lee '942 and Magne-Dirsch et al. By processing only pure ethylbenzene, Lee '942 provides no guidance or expectations as to the outcome of processing mixtures of xylenes with ethylbenzene present in a "minor" amount. The Lee '942 reference provides no hint as to whether other compounds (xylenes) present in the dehydrogenation reaction mixture would compete with ethylbenzene or react with the styrene product.

It is alleged in the final office action that, "It is known to those skilled in the art that in the commercial practice the feed for dehydrogenation could comprise ethylbenzene and other components as claimed by the applicant." No evidence has been presented of this knowledge. Prior art disclosures regarding the dehydrogenation of ethylbenzene to styrene such as US Patents 4,628,136 and US 4,774,378, (Attachments A and B) discussed in the specification on page 3, teach the use of ethylbenzene feedstocks for dehydrogenation processes which do not contain other organic components to obtain polymerization grade styrene. Other disclosures in US Patent 3,308,179 and US Patent 2,959,626 (Attachments C and D) teach the importance of using high purity ethylbenzene in dehydrogenation processes to obtain polymerization grade styrene. The examiner has not presented any evidence to suggest those skilled in the art at the time of applicant's invention thought differently. In the absence of such evidence, the rejection of claims 21-37 and 39-47 under 35 USC § 103(a) is unsupported and should be withdrawn.

Another element missing from the combined teachings of Magne-Dirsch et al (US Patent 6,369,287) and Lee (US Patent 3,306,942) is the feature of converting "at least 50 %" of the ethylbenzene to styrene, although ethylbenzene is only present in a "minor" amount compared to xylenes. Therefore, even if evidence were found to suggest one skilled in art would be motivated or have some reason to reduce the purity of the ethylbenzene feedstocks of Lee '942 to a "minor amount," such evidence alone would not be sufficient to render the claims herein obvious. For the rejection under 35 USC 103(a) to be properly supported, there must be evidence which also shows or suggests that at least 50 % of the ethylbenzene in the feedstock will be converted to styrene. In that combined teachings show only the conversion of high purity feedstocks, such evidence is clearly lacking. It is noted that in comparing

catalysts, Lee '942 maintained low levels of conversion to styrene (1-8%), see col. 5, lines 3-6.

A further element missing from the combined teachings of Magne-Dirsch et al (US Patent 6,369,287) and Lee (US Patent 3,306,942) is the separation of styrene product from a reaction mixture of styrene, metaxylene, orthoxylene, unconverted ethylbenzene and by-products. Magne-Dirsch et al. make no mention of styrene being present in any mixture and its presence would not be expected in these processes since Magne-Dirsch et al. does not disclose any dehydrogenation steps. Lee '942 discloses dehydrogenation of essentially pure ethylbenzene such that the dehydrogenation reaction product would not be expected to contain any xylenes. There is no mention in the disclosure by Lee '942 that any xylenes are present in the products (organic condensate) from the reactor and this organic condensate was analyzed only for styrene, benzene and toluene(see col. 4, last line and col. 5, line 1). The combined teachings of the cited references do not disclose an equivalent step and therefore, provide no indication of how to separate styrene from such a reaction mixture. The separation of metaxylene, orthoxylene, and ethylbenzene disclosed by Magne-Dirsch et al. provides no guidance with respect to separating styrene from these mixtures and clearly provides no guidance in recovering styrene at high purity levels ("at least 98%"), such that this element of the processes claimed is not taught.

Claim 42

In the embodiments defined in Claim 42, the "minor" amount of ethylbenzene within the mixture that is dehydrogenated is further defined as "about 7wt %" ethylbenzene. It is alleged on page 10 of the final action that Magne-Dirsch et al. mention the quantity of ethylbenzene can be "very little." It is not clear from the record when the quantity of ethylbenzene can be "very little" in the processes of Magne-Dirsch. However, since Magne-Dirsch does not mention dehydrogenation of ethylbenzene, any quantification of ethylbenzene in the processes disclosed provides no direction or guidance to lead one skilled in the art to the embodiments defined in claim 42.

Claim 44

Claim 44 defines embodiments even further removed from the combined teachings of Magne-Dirsch et al and Lee '942 in that the dehydrogenation of the distillation raffinate product (ethylbenzene) is performed "without the addition of steam." Magne-Dirsch et al. make no mention of a dehydrogenation step at all and Lee '942 discloses dehydrogenation

processes that employ steam. It is alleged this limitation presents new matter; however, these embodiments are clearly supported by the disclosure which appears on page 15, lines 6-17.

Claims 45 -47

Claim 45 defines embodiments even further removed from the combined teachings of Magne-Dirsch et al and Lee '942 in that the dehydrogenation of the distillation raffinate product (ethylbenzene) is performed "with a catalyst free of iron oxide." Claim 46 also defines embodiments further removed from the combined teachings of Magne-Dirsch et al and Lee '942 since the dehydrogenation of the distillation raffinate product (ethylbenzene) is performed "with a catalyst free of chlorine." Claim 47 depends on claim 45 and further defines the catalyst as comprising "tin and chromium."

As mentioned above, Magne-Dirsch et al. make no mention of a dehydrogenation step at all and so provide no guidance with respect to suitable catalysts. Lee '942 mentions at col. 1, lines 28-33, that known dehydrogenation catalysts usually contain certain metals of Groups IV and VIII of the periodic table, but teaches that an object of his invention is to use an "iron oxide catalyst containing an alkali-promoter which is a compound of an alkali metal and or an alkaline earth metal and a minor amount of chemically combined chlorine." Lee '942 requires that these catalysts employed include iron oxide and chlorine. To perform a dehydrogenation step with a catalyst "free of iron oxide" or "free of chlorine" clearly would not be obvious in view of the teachings of Lee'942.

Claims 22, 27, 29, 30, 32, 34 and 43-47

These claims define embodiments further removed from the combined teachings of Magne-Dirsch et al and Lee '942 in that separation of the reaction mixture containing mostly styrene, ethylbenzene, metaxylene and orthoxylene is further defined as performed in a "second adsorption column" ... "operating as a simulated moving bed." As mentioned above, the cited references do not even mention isolating styrene from xylenes, let alone using an adsorption column to do so. At col. 4, lines 71-73, Lee '942 discloses the effluent gas from the dehydrogenation of ethylbenzene is passed into a water cooled condenser. Samples of the organic condensate are said to comprise styrene, benzene and toluene. No mention is made of isolating styrene from this condensate. The cited references clearly do not show or suggest the separation of styrene using an adsorption column operating as a simulated moving bed such that the rejection under 35 USC §103(a) of claims directed to these embodiments should be withdrawn.

(2) Whether claims 21-37 and 39-47 herein and claims 1-20 of US patent No. 6,841,714 are patentably distinct.

Claims 1-20 of U.S. Patent 6,841,714 (Attachment C) are directed to methods of coproducing paraxylene, metaxylene and/or orthoxylene from a feedstock that contains xylenes, ethylbenzene and C₉-C₁₀ hydrocarbons. The claimed methods of U.S. Patent 6,841,714 do not produce styrene and do not include the requisite steps to prepare styrene (dehydrogenation of ethylbenzene and recovery of styrene from the reaction mixture). It would not be obvious to incorporate the steps necessary to produce styrene in the claimed methods of US 6,841,714 in that ethylbenzene, a known starting material for styrene, is not a desired end product and is not isolated from the xylenes in a form typically used for preparing styrene. The methods claimed include additional steps that provide for the production of paraxylene as well as styrene. This feature is a significant distinction from the methods defined in claims 1-20 of U.S. Patent 6,841,714 such that there is no basis for the rejection under the doctrine of obviousness type double patenting.

It is alleged that based on prior art such as Magne-Dirsch and Lee '942 it would be obvious to prepare styrene from the ethylbenzene produced by the methods of US 6,841,714. No evidence has been presented to support this allegation. While the use of ethylbenzene to prepare styrene was known, it was not obvious that the ethylbenzene in produced in "minor amounts" could be used without purification or further isolation such that the subject matter of claims 21-37 and 39-47 is not obvious in view of the methods claimed within US 6,841,714.

(3) Whether the amendment filed on March 25, 2008 introduces new matter into the disclosure by the addition of new claim 44.

Claim 44 defines methods for coproducing high purity paraxylene and styrene wherein the step of dehydrogenating the distillation raffinate product (metaxylene, orthoxylene, and a minor amount of ethylbenzene compared to the xylenes) to obtain styrene is performed "without the addition of steam." The disclosure on page 15, lines 6-17, of the specification describes the dehydrogenation conditions and does not mention that steam is necessary. Steam is also not mentioned in describing the operating conditions for the unit for dehydrogenating ethylbenzene to styrene used in Example 1 (see page 19, line 20 through page 20, line 5). Methods for dehydrogenation ethylbenzene to styrene with CO₂ were known to those skilled in the art at the time of this invention (See Attachment F, Ikenaga et

al, Dehydrogenation of Ethylbenzene with Carbon Dioxide Using Activated Carbon Supported Catalyst, Abstract, (2/9/2000)). These disclosures support the subject matter of claim 44, particularly in view of the state of the art. Therefore, there is no basis for the objection to the amendment under 35 U.S.C. § 132(a) and claim 44 need not be cancelled.

IX. CONCLUSION

Based on the above remarks, Appellants submit that claims 21-37 and 39-47 are not obvious in view of the cited references and are patentably distinct from the methods of claims 1-20 of U.S. Patent 6,841,714 such that the rejections discussed above should be reversed. The objection to claim 44 as presenting new matter should also be reversed in that the methods defined are supported by the disclosure.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,

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(VIII) CLAIMS APPENDIX

21. A process for coproduction of high purity paraxylene and styrene, starting from a feedstock containing xylenes, ethylbenzene and C9-C10 hydrocarbons, the process comprising the following successive steps:

a feedstock (1) distillation step so as to separate xylenes, performed in a distillation column (2), from which is withdrawn, at the head, a stream (3) comprising most of the metaxylene, paraxylene, ethylbenzene and at least part of the orthoxylene, and from which is withdrawn, at the bottom, a stream (4) containing C9-C10 hydrocarbons, the remaining part is orthoxylene;

a step of subjecting head stream (3) to adsorption in at least a first adsorption column (6) operating as a simulated moving bed and containing numerous adsorbent beds, optionally interconnected in a closed loop, and having a different selectivity for paraxylene, ethylbenzene, metaxylene, and orthoxylene, said column comprising at least four operating zones: a first zone for desorption of paraxylene located between the injection point of a desorbent (5) and the removal point of an extract (7a), a second zone for desorption of ethylbenzene, orthoxylene and metaxylene located between the removal point of extract (7a) and the injection point of adsorption feedstock (3), a third zone for adsorption of paraxylene, located between the injection point of adsorption feedstock (3) and withdrawal of a raffinate product (7b) and a fourth zone, located between the withdrawal point of raffinate product (7b) and the injection point of desorbent (5);

a step of distillation of extract (7a), performed in at least one distillation column (8a), from which is withdrawn substantially pure paraxylene (9a), on the one hand, and on the other hand desorbent, which is then recycled, at least in part, in the first adsorption column;

a step of distillation of raffinate product (7b) in at least one distillation column (8b) from which is withdrawn, on the one hand, desorbent that is recycled at least in part in the first adsorption column and, on the other hand, a distilled raffinate product (9b) containing metaxylene, orthoxylene, and a minor amount of ethylbenzene compared to the xylenes;

a step of dehydrogenation of the distilled raffinate product containing metaxylene, orthoxylene and ethylbenzene to obtain an effluent containing styrene, metaxylene, orthoxylene, unconverted ethylbenzene and by-products, performed in at least one dehydrogenation zone (10), during which at least 50% by weight of the ethylbenzene introduced is converted into styrene;

at least one step of eliminating by-products from said effluent in at least one distillation column, to produce a mixture (18) containing mostly styrene, ethylbenzene, metaxylene, and orthoxylene;

a step of separating mixture (18), in which a first stream (23a) containing styrene with a purity of at least 99.8% by weight is produced and a second stream (23b) containing mostly metaxylene and orthoxylene is produced; and

an isomerization step, in a unit (24), of second stream (23b), optionally in liquid phase, in at least one isomerization zone, at the end of which a stream (25) containing paraxylene, orthoxylene, and metaxylene are recovered and are recycled upstream to feedstock distillation column (2).

22. Process according to claim 21, wherein the step of separating mixture (18) is performed in at least a second adsorption column (20) operating as a simulated moving bed, containing numerous beds of an adsorbent, preferably interconnected in a closed loop and having different selectivity for styrene, ethylbenzene, metaxylene, and orthoxylene, said column (20) comprising at least four chromatographic zones: a first zone, for desorption of styrene, located between the injection point of a desorbent (19) and that of the removal of an extract (21a); a second zone, for desorption of ethylbenzene, metaxylene, and orthoxylene, located between the point where extract (21a) is removed and where an adsorption feedstock comprising said mixture (18) is injected; a third zone, for adsorption of styrene, located between the injection point of feedstock (18) and that of the withdrawal of a refined product (21b), and a fourth zone located between the point of withdrawal of raffinate product (21b) and that of injection of desorbent (19).

23. A process according to claim 21, wherein the extract is distilled to eliminate desorbent from it, the raffinate product is distilled to eliminate desorbent from it, and the recovered desorbent is recycled at least in part to the second adsorption column.

24. A process according to claim 21, wherein first adsorption column (6) is operated in five operating zones, a first raffinate product (7b), enriched with ethylbenzene, is withdrawn from this column and a second raffinate product (7c) is withdrawn between the withdrawal point of first raffinate product (7b) and the injection point of desorbent (5), said adsorption column (6) being then characterized in that it comprises: said operating zones 1 and 2 of first adsorption column (6), a zone 3A for adsorption of paraxylene, located between

the feedstock injection point and the withdrawal point of the first raffinate product, a zone 3B for adsorption of ethylbenzene, located between the withdrawal point of the first raffinate product and the withdrawal point of the second raffinate product, a zone 4 located between the withdrawal point of the second raffinate product and the desorbent injection point.

25. A process according to claim 24, wherein first raffinate product (7b) is distilled in a distillation column (8b) to eliminate from it substantially all the desorbent, first distilled raffinate product (9b) being then conveyed to dehydrogenation zone (10), and second raffinate product (7c) being then distilled in a distillation column (8c) to eliminate from it substantially all the desorbent, second distilled raffinate product (9c), which is recovered substantially free of ethylbenzene, being then directed toward the isomerization zone.

26. A process according to claim 21, wherein the adsorbent used in the first adsorption column is an X zeolite exchanged at barium, or a Y zeolite exchanged at potassium, or a Y zeolite exchanged at barium and potassium.

27. A process according to claim 22 in which the adsorbent used in the second adsorption column is an X or Y zeolite exchanged at sodium or barium or potassium or lithium as well as at potassium and silver.

28. A process according to claim 21, wherein the desorbent of the first adsorption column is selected from the group formed by paradiethylbenzene, toluene, paradifluorobenzene and diethylbenzenes in mixture.

29. A process according to claim 22, wherein the desorbent of the second adsorption column is selected from the group formed by toluene, naphthalene, and its alkylated derivatives.

30. A process according to claim 22, wherein the volumetric ratio of desorbent to feedstock for the first adsorption column is between 0.5 and 2.5, and the volumetric ratio of desorbent to feedstock for the second adsorption column by adsorption is between 0.5 and 3.0.

31. A process according to claim 21, wherein the first adsorption step is performed at a temperature between 20°C and 250°C, and under a pressure between the boiling pressure of xylenes at the operating temperature and 2 MPa.

32. A process according to claim 22, wherein the second adsorption column is operated at a temperature between 20°C and 200°C and under a pressure between the boiling pressure of the mixture at the operating temperature and 2 MPa.

33. A process according to claim 24, wherein the first adsorption column contains at least 24 beds, at least 3 of which are in zone 3B.

34. A process according to claim 22, wherein the second adsorption column contains at least 16 beds, at least 5 of which are in the second zone.

35. A process according to claim 21, wherein fraction (9a) is enriched with paraxylene, to at least 50% by weight of purity, and is conveyed to at least one crystallization zone to deliver paraxylene crystals and a mother liquor, the crystals are separated from the mother liquor, optionally resuspended, washed, and recovered, and the mother liquor is recycled in the first separation column.

36. A process according to claim 21, wherein distillation column (2) is operated so that at least part of a fraction containing orthoxylene is withdrawn at the bottom of the column, said fraction further containing aromatics with at least 9 carbon atoms is conveyed to a distillation column so that an orthoxylene stream with a purity of at least 98.5% by weight is withdrawn at the head and a stream containing aromatics with at least 9 carbon atoms and possibly orthoxylene is withdrawn at the bottom.

37. A process according to claim 21, wherein the separation step of mixture (18) is conducted by a separation technique selected from the group formed by distillation, azeotropic distillation, extractive distillation, liquid-liquid extraction, chemical complex formation, membrane separation, and their combination.

39. A process according to claim 21, wherein second stream (23b) contains at most 10% by weight of ethylbenzene and the isomerization (24) is conducted in the liquid phase.

40. A process according to claim 39, wherein said second stream 23(b) contains at most 5% by weight of ethylbenzene.

41. A process according to claim 39, wherein the isomerised stream (25) represents 60-80% by weight of the total flow to the distillation column 2.

42. A process according to claim 21, wherein said minor amount of ethylbenzene is about 7% by weight.

43. A process for coproduction of high purity paraxylene and styrene, starting from a feedstock containing xylenes, ethylbenzene and C9-C10 hydrocarbons, the process comprising the following successive steps:

a feedstock (1) distillation step so as to separate xylenes, performed in a distillation column (2), from which is withdrawn, at the head, a stream (3) comprising most of the metaxylene, paraxylene, ethylbenzene and at least part of the orthoxylene, and from which is withdrawn, at the bottom, a stream (4) containing C9-C10 hydrocarbons, the remaining part is orthoxylene;

a step of subjecting head stream (3) to adsorption in at least a first adsorption column (6) operating as a simulated moving bed and containing numerous adsorbent beds, optionally interconnected in a closed loop, and having a different selectivity for paraxylene, ethylbenzene, metaxylene, and orthoxylene, said column comprising at least four operating zones: a first zone for desorption of paraxylene located between the injection point of a desorbent (5) and the removal point of an extract (7a), a second zone for desorption of ethylbenzene, orthoxylene and metaxylene located between the removal point of extract (7a) and the injection point of adsorption feedstock (3), a third zone for adsorption of paraxylene, located between the injection point of adsorption feedstock (3) and withdrawal of a raffinate product (7b) and a fourth zone, located between the withdrawal point of raffinate product (7b) and the injection point of desorbent (5);

a step of distillation of extract (7a), performed in at least one distillation column (8a), from which is withdrawn substantially pure paraxylene (9a), on the one hand, and on the other hand desorbent, which is then recycled, at least in part, in the first adsorption column;

a step of distillation of raffinate product (7b) in at least one distillation column (8b) from which is withdrawn, on the one hand, desorbent that is recycled at least in part in the

first adsorption column and, on the other hand, a distilled raffinate product (9b) containing metaxylene, orthoxylene, and a minor amount of ethylbenzene compared to the xylenes;;

a step of dehydrogenation of the distilled raffinate product containing metaxylene, orthoxylene and ethylbenzene to obtain an effluent containing styrene, metaxylene, orthoxylene, unconverted ethylbenzene and by-products, performed in at least one dehydrogenation zone (10), during which at least 50% by weight of the ethylbenzene introduced is converted into styrene;

at least one step of eliminating by-products from said effluent in at least one distillation column, to produce a mixture (18) containing mostly styrene, ethylbenzene, metaxylene, and orthoxylene;

a step of separating mixture (18) in at least a second adsorption column (20) operating as a simulated moving bed, in which a first stream (23a) containing styrene with a purity of at least 99.8% by weight is produced and a second stream (23b) containing mostly metaxylene and orthoxylene is produced; and

an isomerization step, in a unit (24), of second stream (23b), optionally in liquid phase, in at least one isomerization zone, at the end of which a stream (25) containing paraxylene, orthoxylene, and metaxylene are recovered and are recycled upstream to feedstock distillation column (2).

44. A process as in claim 43 wherein said step of dehydrogenation of the distillation raffinate product is performed in at least one dehydrogenation zone (10) without the addition of steam.

45. A process as in claim 43 wherein said step of dehydrogenation of the distillation raffinate product is performed in at least one dehydrogenation zone (10) with a catalyst free of iron oxide.

46. A process as in claim 43 wherein said step of dehydrogenation of the distillation raffinate product is performed in at least one dehydrogenation zone (10) with a catalyst free of chlorine.

47. A process as in claim 45 wherein the catalyst used in at least one dehydrogenation zone (10) comprises tin and chromium.

(IX) Evidence appendix

Appendix of evidence submitted pursuant to §§ 1.130, 1.131, or 1.132 of this title or of any other evidence entered by the Examiner and relied upon by appellant in the appeal, along with a statement setting forth where in the record that evidence was entered in the record by the Examiner. Copies of the evidentiary document are attached.

Reference	Entered in the Record
US Patent 4,628,136 (Attachment A)	Cited in the specification on page 3.
US Patent 4,774,378 (Attachment B)	Cited in the specification on page 3.
US Patent 3,308,179 (Attachment C)	Cited in the response filed on August 28 2008
US Patent 2,959,626 (Attachment D)	Cited in the response filed on August 28 2008
US Patent 6,841,714 (Attachment E)	Cited in the office action mailed January 13, 2007
Ikenaga et al, Dehydrogenation of Ethylbenzene with Carbon Dioxide Using Activated Carbon Supported Catalyst, Abstract, (2/9/2000)). (Attachment F)	Cited in the response filed on August 28 2008

(X) RELATED PROCEEDINGS APPENDIX

(None)

(XII) Appendix of Comments to Pre-Appeal Conferees

(None)